A TREATMENT OF DELPHINIUM FOR ALABAMA AND TENNESSEE

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During field work toward a flora of Alabama and Middle Tennessee I have come across several populations in northern Alabama of what appears to be a new species of *Delphinium*, a species showy even in a genus well known for handsome examples. *Delphinium* in North America according to Professor Ewan (1945) comprises 79 species, with most occurring west of the Mississippi in the U. S., or in Mexico. A scant five, and this including an introduced european, *D. ambiguum* L. have been known previously for the Alabama-Tennessee area. An attempt is made here to present a synopsis of *Delphinium* for Alabama-Tennessee, so as to place a sixth "new" species in context.

The descriptions and keys, while somewhat detailed, are in no way intended to serve in a broad regional-revisional sense; they are based mostly on examples gotten from the two-state area. For a thorough, accurate rendition of the genus for North America the fine work done by Joseph Ewan (Univ. Colorado Studies 2, No. 2, pp. 55-244, 1945) is recommended, together with Ernst Huth's monograph of the world species (1895).

For the purpose of comparing flower parts of the six species, flowers from each were boiled in water and glycerine, spread and drawn. These drawings, together with outlines of blades of lower stem leaves, have been executed free-hand.

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MORPHOLOGY

ROOTSTOCK—Of the six species treated here, *D. ambiguum* is a taprooted annual, *D. exaltatum* has the caudex produced below into a cluster of elongated, somewhat fleshy fibrous-branched taproots, *D. alabamicum* (the new species) and *D. tricorne* have slender, weak stem bases articulated to a fascicle of short-fusiform tuberous roots, and the remaining species have non-tapering stems grading directly to a stoutish caudex, this usually producing subfasciculate, short-tuberous roots.

STEMS—The stems of our *Delphinium* are typically single and erect from the rootstock, tend to be hollow (quite soft-fistulose in *D. tricorne*), and are trichomiferous at least in the inflorescence. Nodes are close-set proximally, gradually or abruptly more distant distally. Branching is not usual below the inflorescence.

SIDA 6(4): 243—265. 1976.

LEAVES—The leaves are both basal and cauline, the former long-petiolate, arising from the rootstock or caudex to form strong rosettes, these leaves together with those of the lower stem usually yellowing or withering by anthesis. The petioles narrow abruptly above from broadly clasping bases, those of rosettes and lower stems longer than the leaf blades, progressively shortening upward on the stem. The leaf blades are in outline mostly broad, ranging from broadly ovate through suborbicular or semicircular to reniform, and are in the five perennials deeply palmatisect into 3-5 primary segments. These are usually cuneate-based, themselves flabellately or pinnately dissected. Width and length of segments varies quite widely within each species, often on the same plant, so that a fairly wide series of examples has to be examined to establish descriptive parameters. Leaf surfaces range from nearly smooth to copiously pubescent.

INFLORESCENCE—The inflorescence in our *Delphinium* is mostly a terminal, indeterminate raceme with the number of flowers ranging widely within species and seeming to be dependent on general vigor of the plant. More vigorous plants will often produce some branches from lower inflorescence nodes, these terminating in racemes. A paniculate inflorescence is sometimes approached in that lower pedicels may themselves produce a few flowers. The pedicels themselves are accrescent. However the usual inflorescence habit is for the ascending to nearly erect pedicels to present flowers in a cylindrical, "spicate" raceme with the flowers at anthesis approximate toward its tip, becoming more distant as the internodes elongate in the aging inflorescence. Each pedicel bears at its base a bract, all but the lowermost usually linear, upward sometimes an additional bract or two, then subterminally a pair of bracteoles.

FLOWER—The flowers of *Delphinium* are developed on a fleshy, convex torus, this facing somewhat away from the axis by a terminal bend in the pedicel tip.

There are 5 sepals, the uppermost largest, longest, produced into a prominent, narrowly conic, elongate slightly curvate spur, this horizontally or upwardly oriented, pointing backward, and from its semicircular orifice producing an upwardly-bent broadish blade. The other 4 sepals are comprised of two somewhat spreading lateral pairs which are subequal in length, but with the upper pair broader, more asymmetrical, usually with the upper edge more rounded than the lower. These are usually of the same color as the spur sepal, the calyx in combination the largest, showiest part of the whole flower. Sepal traces are usually 3, but these ramify shortly above entry into the sepals which often show 5 strong longitudinal veins in the blade, these strongly anastomosing subapically. In 3 of the native species this subapical area is produced into a pouchlike concavity (*D. carolinianum*, *D. vimineum*, *D. exaltatum*). In the rest it is essentially flat, or but slightly produced and evident more as a deeper colored "patch." While the lateral sepals of the perennials are essentially of an oblong or ovate outline and

broad-based, in *D. ambiguum*, the porportionately broader sepals have short but distinct claws. Pubescence of sepals is essentially confined to the outer surfaces and ranges from a fine, usually incurved, puberulence to villous or even strigillose, and is most strongly produced in a broad, median-longitudinal zone.

The petals of the perennial species treated here are in 2 sets of 2. The upper pair produce spurs and are connivent, these spurs enclosed by the spur of the sepal and of a similar length though much narrower outline. Only the spur bases are tubular-conic, their orifices gradually oblique, gradually flattening and widening distally, firm, the edges involuted, the upper slightly curvate, continuous with the spur, the lower produced above the petal attachment into a long, shallow sinus, this bordered at each end by a callus-thickened, broad lobe, the terminal portion an asymmetrically ovate, rather fleshy blade, the apex of which ranges from rounded to sharply emarginate or bifid. These petal blades project up under the spur sepal blade and forward, projecting slightly beyond the sepal apex, and are convergent keel-like along their upper edges, thus forming a broad inverted "V" in front view. The petal traces are single, ramifying just above their entry into 3, 2 of which bend back into the spur, thence upward along the upper margin of the petal into its blade, the third bending directly upward into the blade (see petal drawings). These spur petals are essentially smooth save for minute papillosity or puberulence internally in the spurs (the nectariferous zone) together with, in some cases, longer trichomes on the petal blades. Pigments appear confined to the blades.

The lower pair of petals is clawed, about the length of the lateral sepals and frequently with blades of the same color. The claw bases are short-tubular, strongly folded-keeled, and bear on their upper side proximally an erect or ascending distinctive spur; upwardly the claw twists and is also geniculate apically. Thus the ovate, usually deeply bifid petal blades are twisted outward and somewhat bent downward, with the upper surfaces facing outward in the open flower. In *D. carolinianum* and *D. virescens* especially, these same blades are produced upward into two submarginal longitudinally oriented, fleshy, subalar processes toward their bases. On and in between these zones is a medially-longitudinally oriented, usually villous, beard.

In *D. ambiguum* a very different morphology of the corolla is manifest. The upper petal pair have become fused into a single spur and blade. The spur orifice is even, and from its inner edge between the petal attachment points is a prominent, erect ligule. The blade is suberect, most of its area comprised of two strong auricles together with a broad, very emarginate, terminal lobe. In this species there are no claw petals.

STAMENS—The stamens are rather uniform in character. In all six species they are numerous, set in close spiral, project forward, and are sigmoidly bent. The filaments are strongly flattened and scarious proximally. In *D.*

ambiguum the filament margins converge rather abruptly just above the middle, while in the remainder they gradually converge. Scattered fine hairs are borne on filaments of *D. exaltatum*, *D. carolinianum*, *D. virescens*, *D. ambiguum*. The anthers are basifixed, broadly ellipsoidal, mostly with locule backs smooth, but in a few cases these also with a scattering of short trichomes.

CARPELS—In our natives, the carpels are usually 3, erect and roughly parallel on the torus, the ovaries usually narrowly lanceovoid and tapering gradually into the slender styles, these terminally stigmatose. In *D. ambiguum* but one carpel is produced, the style is shorter, the stigma is broader, flatter, somewhat folded.

FRUIT—All species produce follicles, these subcylindrical or slightly compressed laterally, more or less strongly raised-venose, variously pubescent. Styles harden and persist as beaks on the fruit.

SEED—Seeds of all species treated here are wedge-shaped, truncate, somewhat prismatic, longitudinally 3-4-angled, and are mostly 2.0-2.5 mm long. The surface of seeds of *D. albamicum*, *D. tricorne* is finely hairy, irregularly and sparingly low-ridged, apically somewhat invaginated. In *D. exaltatum* it is strongly longitudinally wing-angled. In *D. carolinianum*, *D. virescens*, *D. ambiguum*, it is produced outward into numerous, horizontally or diagonally oriented, thinnish, lustrous scales.

Ewan (l.c., p. 72) presents a list of characters contrasted for "primitive" and "more advanced" in the genus. In this list it is noted that a plant which has clustered-tuberous (grumose) rootstocks, smooth foliage, mostly basal leaves which are green and functional at anthesis, of 5 entire or little divided primary lobes, non-glandular pubescence, a relatively few-flowered inflorescence (this a raceme), which has the lateral or lower petal blades entire or emarginate, puberulent, and which has triquetous, wingless seeds smooth with firm, opaque outer coats would be considered more primitive. Of our species *D. tricorne* satisfies more of these criteria than do any others, with *D. alabamicum* next in order. These two species then belong in his series IV, the "Tuberiform" series. In contrast to these primitive character aspects would be plants with roots rhizomatous, more fibrous, with herbage of mainly cauline leaves, these withering and dry at anthesis, and blades of 5 pinnatifid to dissected primary divisions, the foliage more pubescent, even pilose, sometimes glandular. The inflorescence would be many-flowered, a panicle or dense spike. The lateral petal blade would be shallowly or deeply bifid, long-hairy. Seeds would be ribbed, papillate or scaly, the outer coats loose; seed angles would be distinctly winged. *D. exaltatum*, (Series IX, the Inornate Series), and *D. carolinianum*, *D. virescens* (Series XII, the Spiciform Series) in the classification adopted by Ewan would be more advanced.

TAXONOMY

Key to *Delphinium* of Alabama and Tennessee

1. The plants annual, from taproots; petals comprised of but 1, fused, spurred member; carpels 1/flower; leaves with segments narrowly linear to filiform. . . . . 1. *D. ambiguum* L.
1. The plants perennial, from caudices or from clusters of fusiform-tuberous roots; petals 4, 2 spurred; carpels 3/flower; leaves with segments linear or broader.
   2. Stems strongly tapering into fascicles of tuberous roots; racemes with pedicels spreading-ascending, the flowers at anthesis well separated, mostly 2-3 cm broad; seeds with outer coat tight, the ridges rounded, the surface finely pubescent; sepal tips with subapical pouch poorly developed or not evident.
      3. Plants mostly between 7 and 10 dm tall; pedicels and upper part of stem with an incurved puberulence mixed with longer, spreading hairs; flowers 2.5-3.0 cm broad, deep blue-purple; follicles spreading-ascending; limestone prairies and glades. . 2. *D. alabamicum* Kral.
      3. Plants rarely taller than 4 dm; pedicels and upper part of stem less pubescent, stems strongly fistulose; flowers 2.0-2.5 cm broad, blue-violet to nearly white; follicles spreading at maturity; rich, usually calcareous, woodlands. . . . . 3. *D. tricorne* Michx.
   2. Stems but slightly if at all tapering into thicker, erect caudices, these branching below into thickened roots, or subtended by close-set, fusiform tubers; racemes with pedicels more ascending, thus inflorescence narrower, the flowers at anthesis seldom broader than 2.0 cm; seeds longitudinally winged along the angles or with numerous, transversely oriented squamellae; sepal tips with prominent, subapical "pouch."
      4. Principal lobes of larger leaves showing, on lower surface, 1 strong median nerve and at least a pair of prominent lateral nerves; pubescence of pedicels and of upper part of stem short-incurved; follicle bodies 1 cm long or less; seed longitudinally winged along the angles; flowers pale, dull blue. . . . . 4. *D. exaltatum* Ait.
      4. Principal lobes of larger leaves narrower, the lower surface showing only a strong median nerve; pubescence of pedicels and upper part of stem mostly spreading-strumose; follicle bodies 1.5 cm long or more; seed with numerous transversely oriented scales; flowers bright blue or near white.
         5. Flowers blue or bluish. . . . . 5. *D. carolinianum* Walt.
         5. Flowers white, greenish-white, or tinged with blue or lavender, in any event never bright blue. . . . . 5. *D. virescens* Nutt.

1. DELPHINIUM AMBIGUUM L., Sp. Pl. ed. 2, 749. 1763., Fig. 1.

D. *ajacis* sec. J. Gay, Desmoulins (at. Dordogne 12 (1840).

Taprooted annual, the stem usually solitary, erect, terete, up to 1 m tall, retrorsely puberulent proximally, smoothish medially, antrorsely puberulent distally, the nodes rather closely spaced the length of the stem. Lowest leaves withering by flowering time, of those present the lowest largest and longest-petioled, the petioles spreading-ascending-puberulent, the blades mostly ovate to suborbicular, 3-pinnately dissected into narrowly linear to filiform,

puberulent secondary and tertiary segments, the tips of which are acute, callused, those of mid and upper stems becoming short-petioled or sessile, ternately and then pinnately divided, mostly overlapping (the stems thus appearing quite leafy). Inflorescence a simple, spicate raceme, or plants branching, each branch terminating in a spicate raceme, the flowers numerous and overlapping on puberulent, ascending pedicels shorter than the flowers, each pedicel subtended by a linear to ternate bract and distally bearing a pair of puberulent bracteoles. Perianth segments ranging from deep blue-violet through pale blue to pink or white. Spur sepal ca. 2.5 cm long, the spur ca. 1.5 cm long, the blade broadly to oblong to ovate, the veins converging toward the short-acuminate apex, these closely anastamosing, forming a greenish-yellow pouch subapically, the outer surfaces puberulent. Upper lateral sepal pair ca. 1.5 cm long, short-clawed, the claw ca. 3 mm long, the blade broadly ovate, apically obtuse-angled, marginally sinuate-erose, the veins converging, anastamosing, forming part of a pouch as in the spur sepal, the claw surfaces villosulous, the backs with a broad, longitudinal, yellowish-green, villous zone terminating at the subapical pouch. Lower pair of sepals about as long, slightly shorter-clawed, the blades unequilaterally ovate (the broader side upward), margined and veined as in the upper pair and with similar indumentum. Spur petals fused into 1, fully 2.5 cm long, thus prominently exserted beyond the spur sepal, the spur tube intact from spur tip to petal attachment, producing at its orifice and opposite the blade base an erect, broadly rounded ligule 3 mm high, this joined nearly its length with the petal blade auricles; petal blade ovate, of two prominent, spreading rounded auricles, the blade base nearly 1.5 cm across the auricles, and tipped by a short obovate to suborbicular, terminal lobe, this broadly bilobate apically, the inner surfaces along the auricle bases sessile-glandular within, the blade colored as in the sepals, the spur yellowish-white or greenish. Claw petals absent. Stamens ca. 6 mm long, the yellowish green anthers ca. 1 mm long, broadly ellipsoidal, the filaments broadly flattened proximally, abruptly narrowing above the middle, with a scattering of fine hairs. Carpel solitary, ca. 8 mm long, lance-ovoid, the body appressed-tomentulose, the style short, 1 mm long or less, the stigma broad, fleshy, oblique. Follicle lance-ovoid, including the short-excurved style and stigma fully 2 cm long, appressed incurved-puberulent. Seed wedge-shaped, truncate, 2.0-2.5 mm long, brownish, 3-4-angled and ridged, the faces with transversely oriented, low, wavy-margined scales.

This European species has escaped cultivation throughout our range, and is found in a variety of disturbed soils if they be sunny and dryish. It is particularly abundant in middle Tennessee in fields and along the roads, often in association with *Centaureum cyanus* and various species of annual bromegrasses. It flowers from early May through July. Plainly, it is a member of a very different complex of *Delphinium*, with its fused spur petals, its lack of claw petals, and with its single carpel. As Professor Ewan has noted

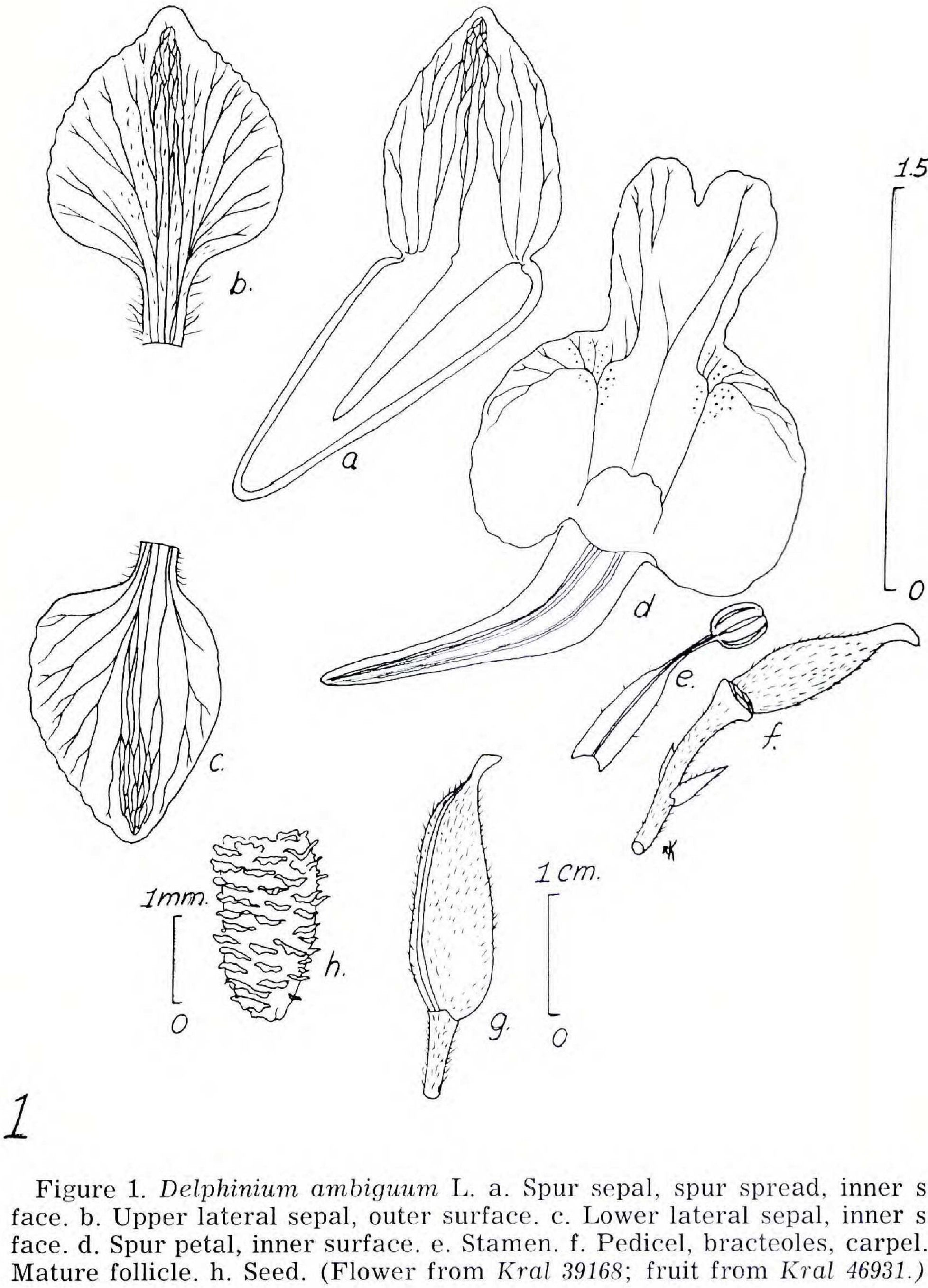

Figure 1. *Delphinium ambiguum* L. a. Spur sepal, spur spread, inner surface. b. Upper lateral sepal, outer surface. c. Lower lateral sepal, inner surface. d. Spur petal, inner surface. e. Stamen. f. Pedicel, bracteoles, carpel. g. Mature follicle. h. Seed. (Flower from *Kral 39168*; fruit from *Kral 46931.)*

(l.c.) its young stems, with the closely set, finely dissected lower leaves are very reminiscent of some Umbelliferae (e.g. *Daucus*).

2. DELPHINIUM **alabamicum** Kral, sp. nov. Fig. 2.

Herba perennis, caudici brevi tenui descendente radicibus fasciculis fusiforme brevis. Caulis 5-10 (-15) dm longis, teres, inferne rubrotinctis glabris aut retrorse pilosis, superne retrorse effuseque pilosis. Folia multis, infima sub anthesi marcescentes aut persistentes, petiolis elongatis, laminis semicircularis vel orbicularis v. suborbicularis, 5-10 cm latis, palmatisectis, segmentis primis 3-5, pleurumque 3-6 cm longis, linearis vel oblongo-linearis basi anguste cuneatis subtis sparsis piloso-hirsutis. Racemi patentes, pedicellis inferioribus arcuatisve atque bracteatis, saepe confertis antrorse tomentulis etiam pilosis. Sepalis oblongo-ovatis, 2.5-3.0 cm latis, profunde cyaneo-ionanthis, acutis vel brevi acuminatis; calcar longissima ca. 3 cm longis. Unguis petalis laminis ovatis profunde fissis longo-ciliatis. Folliculis oblongis 1.5 cm longis, apice patulis. Semina cuneata truncata subtriquetra 2 mm longa; testa nigrescentia minute pubescentibus.

Perennial from a fascicled set of fusiform-tuberous roots, to which is jointed a short, many-noded, narrow-tapering caudex. Stems mostly 5-10 (-15) cm long, usually solitary, erect, terete, at anthesis with basal nodes and internodes brownish, close-set, often leafless, then above with internodes rather abruptly elongating, the surfaces below often reddish-tinted, glabrous or pilosulous with hairs retrorsely curved; internodes of mid and upper stem longest, much longer than subtending leaves, pale yellow-green, sparsely to copiously recurved-puberulent or pilose, with an admixture of longer, spreading trichomes; peduncle and inflorescence axis mostly densely recurved-puberulent, also spreading-pilose. Rosette leaves (these often absent by anthesis) and lower stem leaves palmatisect, the segments flabellately spreading into a semicircular or orbicular outline, on slender, pilose to nearly smooth petioles much longer than the blades; primary segments 3-5, mostly 3-6 cm long, joined only at very base, linear or oblong-linear, cuneate-based, bifidly or trifidly branching into short to elongate-linear, spreading-ascending ultimate segments, these mostly acute, nipple-mucronate, the callus whitish, apically depressed; leaf surfaces yellowish-green, the upper smoothish, the lower with scattered pilosity and puberulence, this also along the margins. Leaves above mid-stem increasingly reduced, becoming sessile, mostly 3-lobed, the uppermost sessile, linear. Flowers either in a single terminal raceme or in an open, few-branched paniculate system, the total inflorescence often fully ½ the total plant length and of 15 or more flowers. Pedicels spreading, arcuately ascending, slender, the lowest longest, often several cm in length, all by anthesis longer than the flower they subtend, mostly subtended by a single, linear, acute villosulous and hirsute bract and each with 2 or 3 short-linear, similarly hairy bracteoles distally; pedicel surfaces both densely incurved-tomentulose and spreading-hirsute. Sepals an intense, deep, blue-violet, 2.5-3.0 cm broad and from tip of longest segment to tip of spur fully 3.0 cm long. Spur sepal 3 cm long, the spur 1 cm long, the blade broadly oblong, apically acute or short-acuminate, the

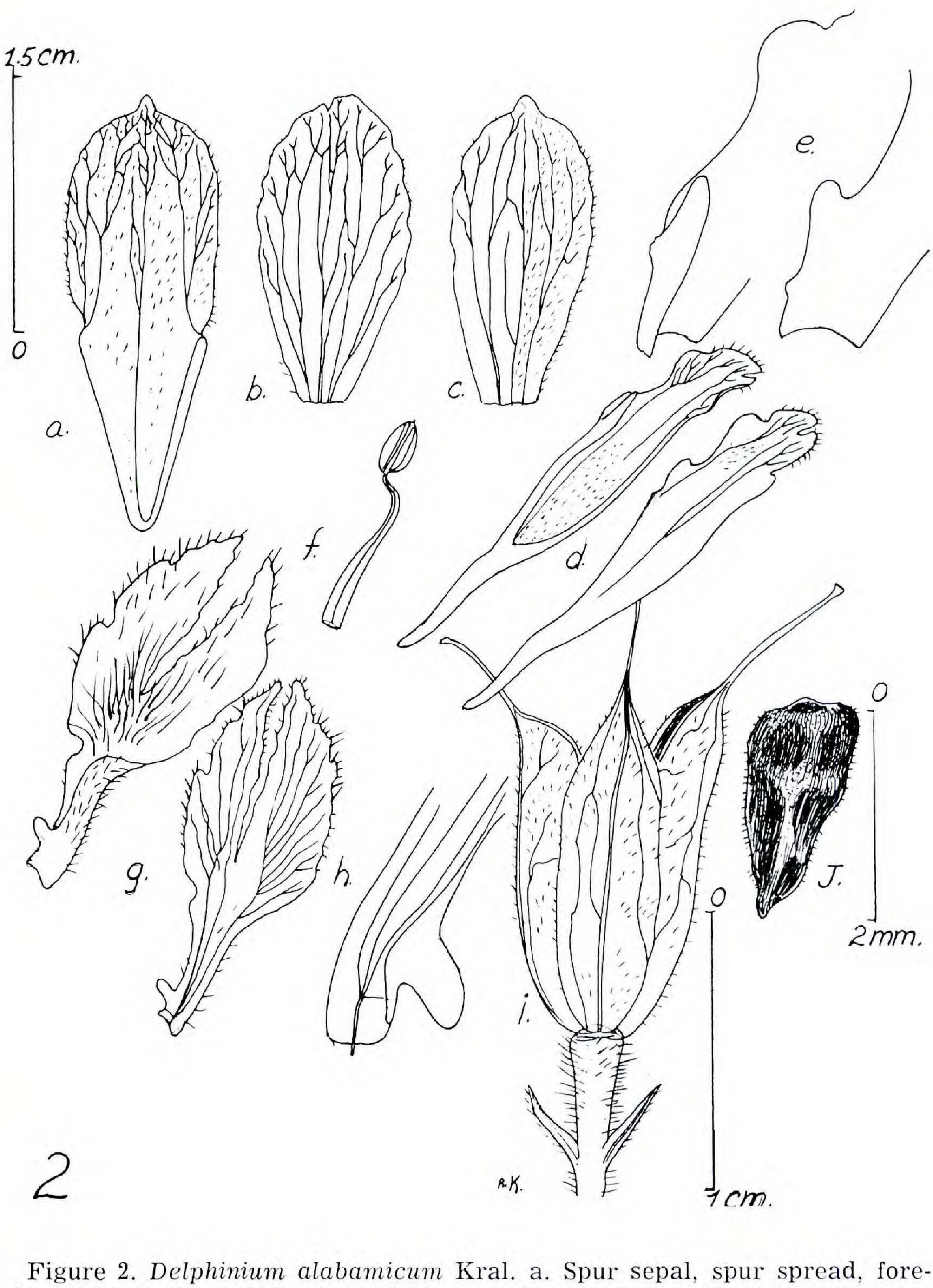

Figure 2. *Delphinium alabamicum* Kral. a. Spur sepal, spur spread, foreshortened. b. Upper lateral sepal, inner surface. c. Lower lateral sepal, outer surface. d. Spur petals. e. Spur petal blade base, much enlarged inner and outer views. f. Stamen. g. Claw petal. h. Base of claw petal. i. Pedicel and mature fruit. j. Seed. (Flower and fruit drawn from holotype, *Kral 39113*.)

margin spreading-ciliolate, the inner surface smoothish, the outer surface spreading-pilose. Lateral sepal pairs subequal, mostly oblong or obovate, ca. 1.5-1.7 cm long, acute to obtuse, broadly cuneate-based, the outer surfaces (backs) strongly strigose or hirtellous, particularly in the median-longitudinal zone. Spur petals ca. 3 cm long, the closed part of the spur ca. 1 cm long, the blade pale blue to near white, ovate, apically acutish, with a narrow, subapical cleft, the margins ciliate, the backs pilosulous or pilose; inner surface of spur minutely puberulent, that of blade sometimes with scattered pilosity along larger veins. Claw petals bluish, ca. 1.5 cm long, the claw ca. 0.5 cm, bearing at its upper margin basally a spreading, short-oblong, erect auricle, the blade elliptical or ovate, ciliate-erose, cleft narrowly from the roundish or acute apex nearly to the attenuate base, the backs villous, the inner surfaces pilosulous. Stamens ca. 1 cm long, the filaments flattened proximally, gradually narrowing and thickening toward the connective, smooth or sparsely hirsute; anthers ellipsoidal, usually smooth. Carpels narrowly lance-ovoid, ca. 0.5 cm long, the ovary sericeous. Mature follicle bodies oblong, ca. 1.5 cm long, slightly spreading apically, the styles ca. 0.5 cm long, slender, persistent, arching outward. Seeds somewhat asymmetrically obconic, obtuse-angled, truncate, 2 mm long, minutely soft-spreading-hairy, nearly black.

Heavy soil of calcareous clearings in cedar barrens, blackland prairies, black belt Alabama (where perhaps now exterminated) and in the Highland Rim of northwestern Alabama. Flowering from May to mid-June.

Type. ALABAMA. Franklin Co.: limestone glade ca. 5 mi. s. of Russellville by US 43-Alabama 17, 26 May 1970. *R. Kral 39113*. Holotype US. Isotypes to be distributed.

My observations of this species so far are confined to populations scattered in Franklin County Alabama where it is locally abundant in open limestone glades, there in association with such plants as *Petalostemon gattingeri, Arenaria patula, Leavenworthia* spp., *Psoralea subacaulis, Onosmodium molle, Schoenolirion croceum*, etc. Usually it is on heavy clay and in full sun, though scattered individuals may be found amongst invading *Juniperus virginiana* and other early woody successional stages. Examination of specimens in the U.S. National Museum has shown specimens of C. Mohr identified as *D. exaltatum* and gotten from Uniontown (Perry County) and Cedar Plain, thus the species at least at one time was to be found in the Black Belt prairies. Mohr cited it under *D. urceolatum* Jacq.,[(this, according to Ewan (l.c.) based on a garden grown plant of unknown origin, possibly however of the European *D. elatum*)] used *D. exaltatum* as a synonym, and indicated (1901) that this plant was found in Lawrence County (Moulton) and Dallas County (Marion Junction). From his description of the color of the flowers and the habitat, as well as from those specimens of his I have seen, there is little doubt that the plant Mohr referred to is the same as this "new" species. However, my own attempts to find *D. alabamicum* at any of these

Black Belt localities have thus far been futile. These open lands have been so suitable for row crop agriculture or improved pasture that it has possibly been wiped out in that part of its range.

D. alabamicum appears as an interesting combination of the characteristics of *D. tricorne* and *D. carolinianum*. It has the short, weak, tapering caudex and tuberiform rootstock, together with the larger, more spreading-pedicelled flowers of the former and, like it, has the subapical sepal "pouch" poorly if at all developed. On the other hand its taller habit, its pilosity of stems and petals, and its narrower leaf segments are toward *D. carolinianum*. Further, its mature follicles ascend more than is the case in *D. tricorne*, less than in *D. carolinianum*. The seed, while similar in general character to that of *D. tricorne*, is black.

Plants moved to my garden in Nashville have bloomed true to character for two years and, because of their stature, large, numerous, showy flowers, and relatively long period of bloom, make a very handsome sight.

3. DELPHINIUM TRICORNE Michx., Fl. Bor. Am. 1: 314. 1803.

Delphiniastrum tricorne (Michx.) Nieuwl., Am. Midl. Nat. 3: 172. 1914.

Stems usually solitary from a small cluster of fusiform-tuberous roots, erect, 1-4 (-6) cm tall, stiffish but soft, hollow, the lower part with short, zig-zag, narrow internodes (the caudex) tapering into the fascicled tubers; internodes abruptly broader above the caudex, elongating and longest toward mid-stem, then tapering gradually upward on a (usually) long primary peduncle; stem surfaces brownish or maroon-tinted proximally, becoming greenish-stramineous, even reddish-tinted upward, smooth or sparingly decurved-pilose proximally but often with a heavier, incurved pilosity in the inflorescence. Leaves few, tending to be concentrated toward the stem base, the lowest scale-like on the first 1-2 nodes, those just above largest, spreading or ascending on pilose petioles several times longer than the blades, the blades mostly orbicular to reniform in outline, deeply palmatisect, the primary segments mostly (3-) 5 (-7), in outline mostly oblanceolate or cuneate, themselves dissected into narrow fans, the sinuses narrow, the ultimate lobes mostly oblong to short-oblong, narrowly triangular or ovate, acute to nipple-tipped; leaf surfaces pale green, the upper darker, smoothish to appressed-puberulent or scattered-pilose, the lower strongly to weakly pilose, hairs longest and most abundant along the veins. Leaves becoming abruptly smaller and sessile just below the primary peduncle, the inflorescence bracts commonly unlobed or few lobed, the uppermost ones short-linear. Inflorescence a simple raceme or a compound of a few racemes, the flowers few and distant or many and somewhat crowded, cylindric, or narrowly conic, the spreading-ascending slender pedicels longest toward the raceme base, pilose to tomentulose, mostly subtended by a short-linear or lanceolate, pilosulous bract and producing a pair of subopposite, linear-lanceolate bracteoles ca. 3 mm long just below the torus. Sepals from deep

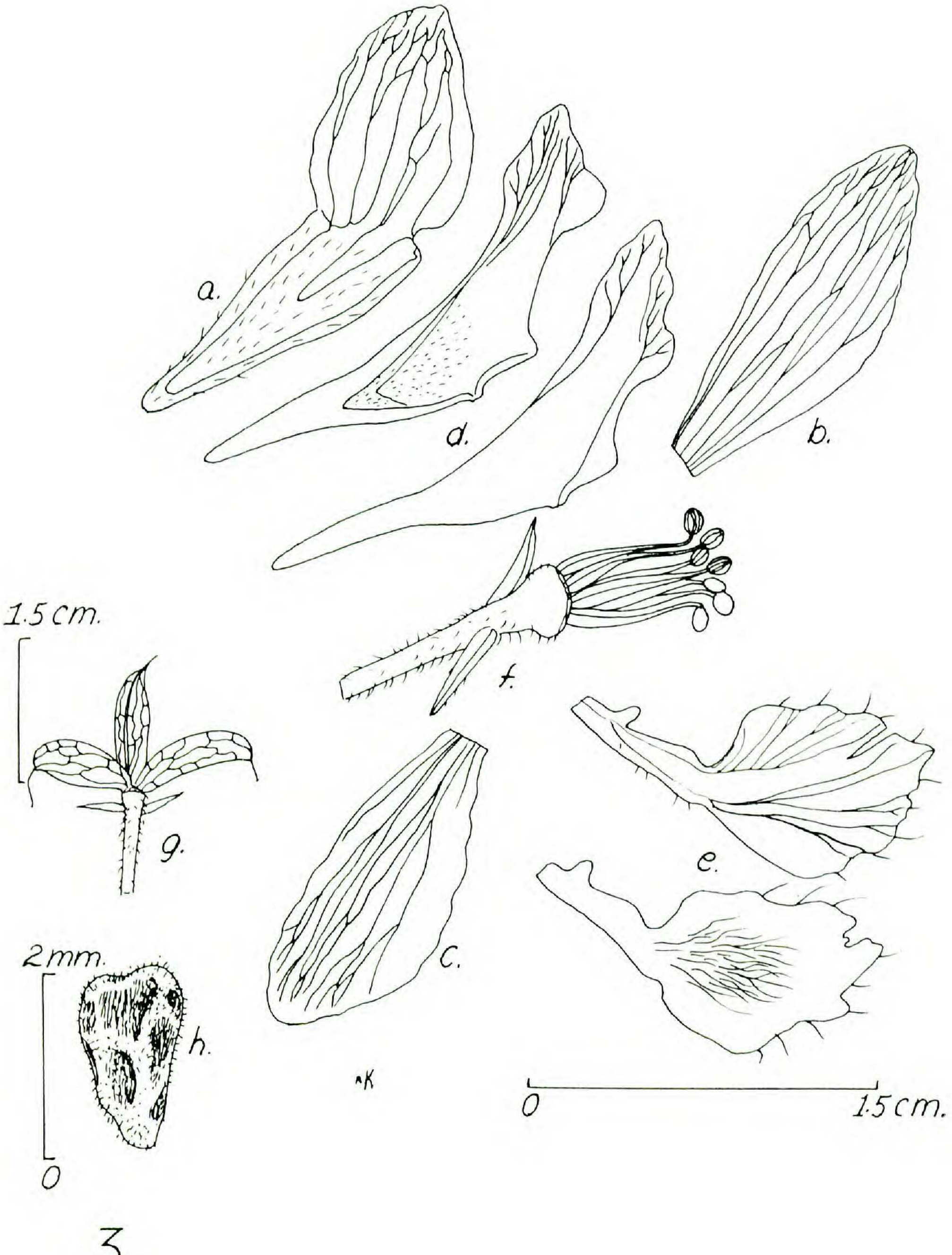

Figure 3. *Delphinium tricorne* Michx. a. Spur sepal, spur spread, outer surface. b, c. lateral sepals. d. Spur petals. e. Claw petals. f. Pedicel, receptacle, stamens. g. Ripe fruit. h. Seed. (Flower parts from *Kral 45638*; fruit and seed from *Quarterman et al. 4904*.)

blue-violet through pale blue to near white with lavender splotches subapically on sepal tips. Spur sepal 2.0-3.0 cm long, the narrowly conic spur ca. 1.5 cm long the somewhat spreading blade broadly oblong, obtuse, slightly crispate to subentire, ciliolate, the outer surface scattered-pilose. Lateral sepal pairs subequal, somewhat asymmetrically elliptic-oblong, 1.5-1.8 cm long, rounded, ciliolate and wavy-margined, externally scattered pilose in a broad median-longitudinal zone. All sepal blades with main veins arcuately converging and anastomosing subapically, there forming a somewhat thicker, sometimes slightly pouched zone. Spur petals ca 2 cm long, the petal attachment ca. 1.5 cm from the spur tip, the spur closed for 8-9 mm from the tip; petal limb irregularly oblong, terminally asymmetrically ovate, the margin sinuous-crispate, the apex bluntly acute, the surfaces smooth above save for puberulence within the spur, sparsely villosulous externally. Claw petals usually deeper colored than the spur petals, but paler than the sepals, ca. 1.5 cm long, the claw 5-6 mm long, the blade broadly ovate to suborbicular, the margin strongly sinuate to erose, the apex rounded with a strong narrow, shallow to deep cleft subapically; upper surface of blade strongly pale-villous at least proximally and medially, there marked also by a yellowish-white medial patch. Filaments about 7 mm long, smooth or sparsely ciliate; anthers asymmetrically suborbicular, ca. 1 mm long. Carpels lance-ovoid, smooth or with scattered weak appressed hairs on the ovaries. Mature follicles, including the persistent style, narrowly oblong, laterally somewhat compressed, ca. 1.5 cm long, strongly outwardly curvate, nearly smooth or scattered-pilose. Seeds dark brown, irregularly wedge-shaped, truncate, ca. 2 mm long, minutely spreading-puberulent.

Rich, moist, mostly circumneutral or slightly basic loamy soils of deciduous woodlands from Pa. south into Ga., westward into Minn. and Okla. In our area this is the common woodland *Delphinium* from northern Alabama through most of Tennessee. Here it flowers from late March to early June.

In richest sites the fistulous stems become quite stocky and tall, but in large populations on average sites most plants do not exceed 3 dm. By the time the fruits appear the plants are already beginning to die back, usually completely so by July. In the calcareous woodlands of northern Alabama and middle Tennessee there are many populations that are prevalently white or yellowish-white with tints of lavender or blue-violet, or this confined mainly to the spur sepal. These same show deeper splotches of color in the subapical, anastomosed, sepal zone of the sepals.

In open woods which have had a history of grazing and then abandonment, this species is one of the first herbaceous elements to return. The plants are definitely toxic to livestock and probably sustain damage only through alteration of the soil through trampling by stock.

4. DELPHINIUM EXALTATUM Ait., Hort. Kewensis, ed. 1. 2:244. 1789.
D. tridactylum Michx., Fl. Bor. Am. I: 314. 1803.
Delphinastrum exaltatum (Ait.) Nieuwl., Am. Midl. Nat. 3:172. 1914.

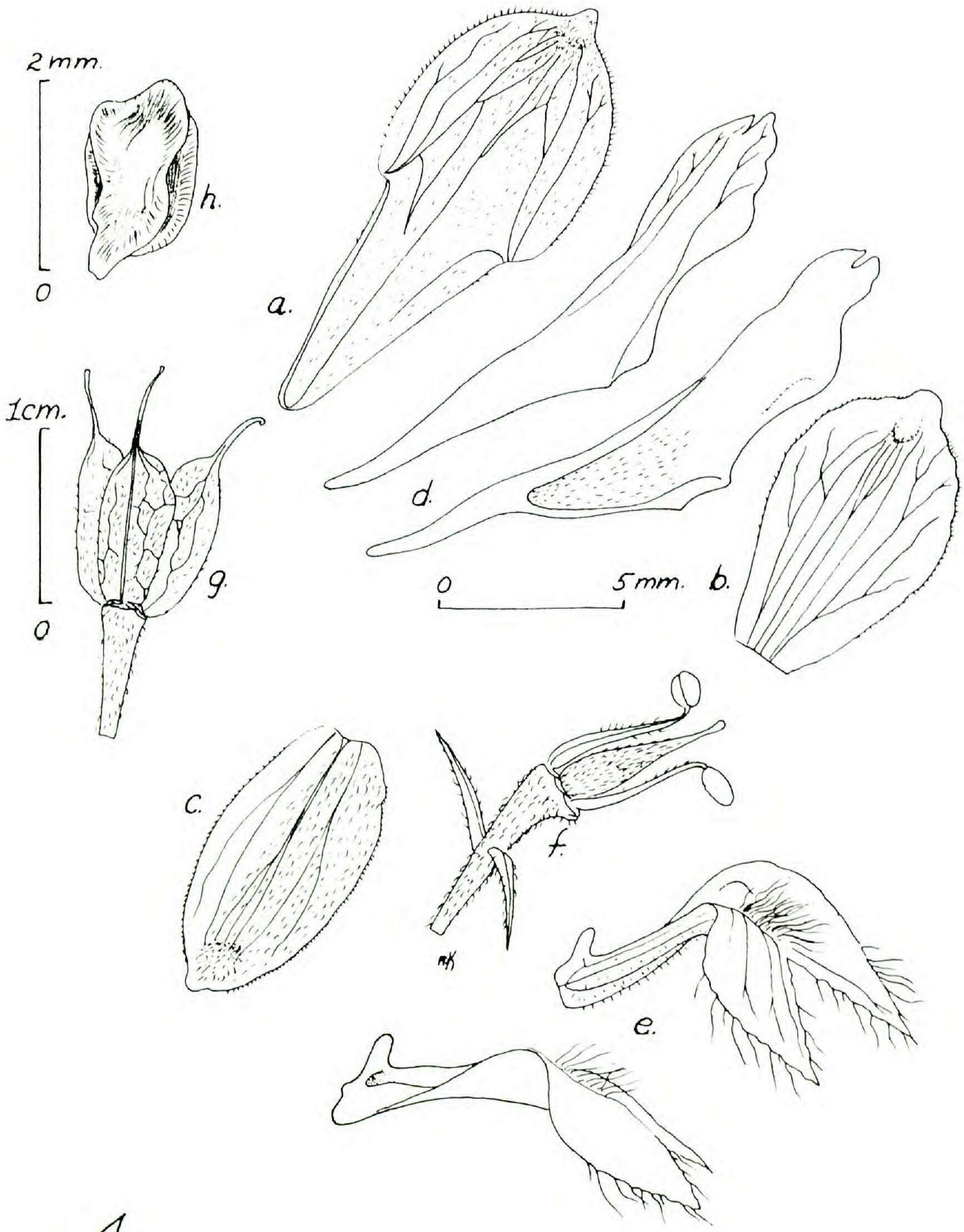

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Figure 4. *Delphinium exaltatum* Ait. a. Spur sepal, spur spread, outer surface. b. Upper lateral sepal, inner surface. c. Lower lateral sepal, outer surface. d. Spur petal pair, lower showing inner surface. e. Claw petal pair. f. Pedicel, bracteoles, receptacle, stamens, and a carpel. g. Ripe follicles. h. Ripe seed. Drawn from *Kral 11137* (Montgomery Co., Virginia).

Stems usually solitary from a thickened, woody, taprooted (or branched-taprooted) caudex, erect, 1.0-1.5 m tall, terete to somewhat sulcate, slender but firm, the lowest internodes shortest, usually purplish tinted, smooth, gradually lengthening toward mid-stem, longer than the shortening petioles and blades; stem surfaces above base greenish or stramineous, smooth to the level of the inflorescence, there increasingly crisped-incurved-puberulent toward the apex. Lowest leaves gone by anthesis, the lowest green ones on terete, slender, glabrous to sparingly hirsute petioles longer than the blades, the blades in outline suborbicular to semi-circular, usually truncate-based, deeply and palmately divided into 3 (-5) oblanceolate to elliptic-linear or lanceolate primary segments, the sinuses narrowly acute to narrowly rounded, the segment bases broadly to narrowly cuneate, the secondary segments from 1- several, the lowest oblong-linear, salient to ascending, the shorter narrowly triangular, all segment tips narrowly acute to acuminate, somewhat thickened but still flattish, lacking mucrones; leaf surfaces deep green above, paler beneath, sparingly incurved pubescent along the margins and the several parallel veins above, more generally appressed pubescent beneath. Leavs grading gradually upward into the inflorescence, this usually a compound of slender, elongate racemes of numerous flowers, the basal well separated, the ones at anthesis or in bud approximate, the pedicels slender, ascending at an angle of about 45° or less, crisped-tomentulose, each subtended by a linear, acuminate, incurved-puberulent bract together with a distal pair of short-linear or oblong, puberulent or tomentulose bracteoles. Sepals pale dull blue or blue-violet, this lined with yellow-orange or yellow-white. Spur sepal ca 2 cm long, the spur 1 cm long, the blade broadly ovate, short-acuminate or mucronate apically, with a subapical shallow pocket, marginally ciliolate, the back crisped-puberulent. Other sepals broadly oblong to obovate, ca. 9 mm long, the upper pair somewhat broader, apically rounded or with a low mucrone, each with a subapical pouch, the margins erose and ciliolate, the backs medially puberulous in a broad zone, the inner (upper) surfaces smooth. Spur petals slightly longer than the spur sepal, the closed (tubular) part of the spur ca. 5 mm long, the attachment point ca. 10 mm from the spur tip, the limb with the lower edge bearing a long shallow sinus between 2 thickened low lobes, the limb apex asymmetrically ovate, blue, sparingly trichomiferous apically bifid into 2 unequal, narrowly triangular lobes. Claw petals 1.0-1.2 cm long, blue, the claw ca. 5 mm long, bearing just above its short-compressed-tubular base an upward projecting spur ca. 0.5 mm long; blade broadly, asymmetrically ovate, strongly bent downward, bearing a pair of longitudinally oriented, low calluses on either side of the mid-nerve at the claw junction, deeply split by a narrowly acute sinus, the lobes unequal, narrowly acute, the margins erose and long-ciliate; upper (inner) surface of blade strongly villous medially; lower (outer) surface of claw puberulous, of blade sparingly villous. Stamens ca. 5 mm long, the anthers ca. 1 mm long, ellipsoidal, the locules

sparingly short hairy, the filament margins sparsely ciliate. Carpels ca. 5 mm long, the ovaries ca. 2.5 mm long, narrowly lance-ovoid, sericeous. Mature follicles erect, diverging only apically, short-oblong, ca. 9 mm long, incurved-puberulent, the persistent glabrous style ca. 2 mm long, excurved. Seeds asymmetrically cuneate, truncate, alately 3-angled, 2.0-2.2 mm long, buff or pale brown.

Rich, moist loamy soils of open calcareous wooded ravines, mainly in the mountains, Penn. and Ohio south into N.C., Tenn. and Ky. (Mississippi?).

This, with the possible exception of *D. alabamicum* is the rarest of the Delphiniums of the southeastern United States. My own field experience with it has been limited to the mountains of southwestern Virginia where it is of sporadic occurrence in mixed-mesophytic forested ravines that cut into shales and limestones. It has a deep, heavy root system in comparison with our other species, and the smallish flowers are less attractive, being of a dull shade of blue. It tends also to be more branched, the main axis putting forth several upwardly arching lateral shoots. While the other species tend often to be locally abundant, sometimes forming stands, this is usually scattered with but few plants in any locality.

5. DELPHINIUM CAROLINIANUM Walt., Fl. Car. 155. 1788.
Delphinium azureum Michx., Fl. Bor. Am. 1:314. 1803.
Delphinastrum carolinianum (Walt.) Nieuwl., Am. Midl. Nat. 3:172. 1914.

Stems solitary or few from a stoutish, erect caudex, this frequently tuberously branched, or a small fascicle of fusiform tubers, erect, to 1.5 meters tall, terete, slender but firm, the lowest internodes shortish, maroon or red-tinted, these gradually lengthening toward mid-stem, there much longer than subtending petioles; stem surfaces below mid-stem usually copiously puberulent with pale, downcurved hairs, above mid-stem at least in the inflorescence strumose-hirsute with yellowish (often glandular) hairs and/or crisped-pale-puberulent. Rosette leaves and lowest stem leaves absent by anthesis, the lowermost leaves long-petiolate, the blades tenuisect, in outline semicircular, the primary divisions usually 3, each linear-based and pinnatifid, the secondary segments broadly to narrowly linear, spreading or ascending, simple or themselves sparingly pinnatifid; segment apices narrowly acute, terminating in a conic pale callus; surfaces of petioles puberulent to pilose, those of segments with pale, incurved trichomes along the margins and mid-veins at least beneath. Uppermost leaves sessile or nearly so, with fewer, narrower segments. Inflorescence a single, narrow, elongate raceme or a sparse ascending-branched system of these, the numerous flowers on (usually) shortish, erect to strongly ascending, hirsutulous and/or puberulous slender, stiffish pedicels, each subtended by a short (mostly less than 1 cm), lance-linear, appressed-hairy bract and with (1-) 2-3 (-4) still shorter bracteoles, 2 usually present and subopposite near the torus. Sepals usually a bright, pale blue or blue-violet. Spur sepal 2-3 cm long, the nar-

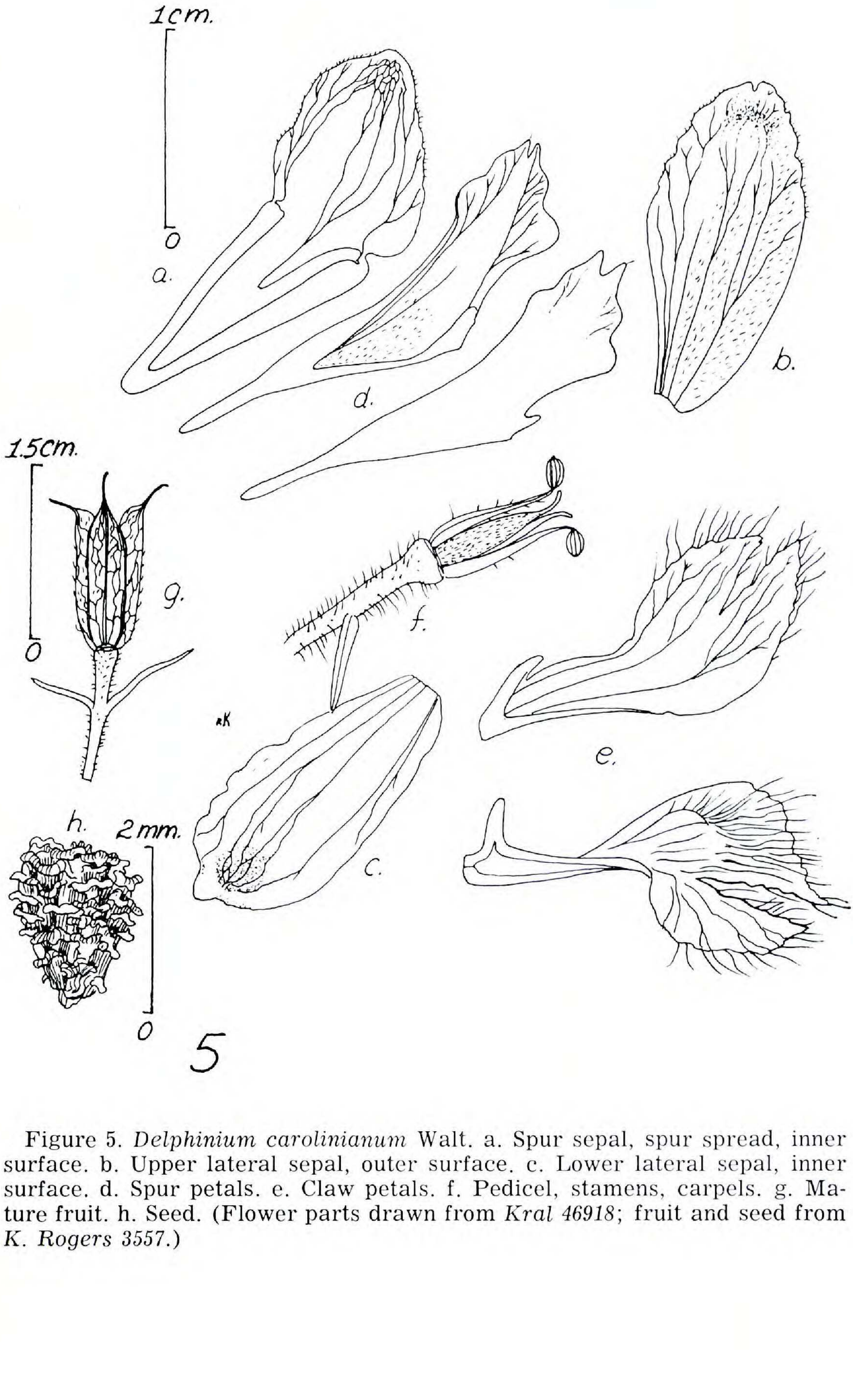


Figure 5. *Delphinium carolinianum* Walt. a. Spur sepal, spur spread, inner surface. b. Upper lateral sepal, outer surface. c. Lower lateral sepal, inner surface. d. Spur petals. e. Claw petals. f. Pedicel, stamens, carpels. g. Mature fruit. h. Seed. (Flower parts drawn from *Kral 46918*; fruit and seed from *K. Rogers 3557*.)

rowly conical spur between ½ and ⅔ the total length, the blade bent upward, ovate, apically broadly acute or obtuse and bearing a large, subapical, shallow "pouch," the margin entire, or undulate, the outer surface appressed or incurved puberulent, the inner (lower) surface smoothish. Other sepals 1.0-1.5 cm long, oblong, acute to rounded, entire to erose and ciliolate, each producing subapically a dark-colored shallow pit or pouch; sepal backs crisped or appressed puberulent, with a villous or pilosulous broad median zone, the hairs most abundant on the sepal pouch. Spur petals 2.2-2.5 cm long, the tube 7-8 mm long to the sinus, ca. 1.5 long to the attachment point, the lower edge of the blade with sinus between callused lobes ca. 5 mm long, the lobe apex ovate, acute, apically bifid, the lobe tips blue, bluntly acuminate, sometimes with a few long pale, tufted trichomes. Lower petals 1.0-1.2 cm long, the claw ca. 5 mm long, bearing at its short-tubular base an upwardly directed narrow spur 1.5-2.0 mm long and apically 2 short, longitudinally oriented calluses; blades downwardly directed, ovate, acute, long-ciliate, nearly split by a narrow, deep sinus, blue, the upper surface villous with long yellowish hairs, the backs glabrous. Stamens ca. 7 mm long, the flattish filaments sometimes with a few long hairs, mostly smooth, the anthers broadly ellipsoidal, sometimes with locule backs having a scattering of slender, but rigid short white hairs. Carpels with ovaries lance-cylindrical, appressed-tomentulose, ca. 2 mm long, the styles usually blue, ca. 1 mm long, glabrous. Follicle bodies asymmetrically oblong, erect, diverging only apically, incurved puberulent, ca. 1.0-1.5 cm long, the persistent styles ca. 3 mm long. Seed broadly wedge-shaped, 1.7-2.0 mm long, truncate, grayish, with (usually) 3 prominent longitudinal ridges and numerous, irregularly transversely oriented scale-like processes.

Moist to dryish, usually calcareous, clearings, limestone outcrops, glades, prairies, throughout black belt Alabama and locally abundant, scattered elsewhere in the state. Flowering from early May through July. The species is more abundant and widespread west of the Mississippi, ranging from Illinois and Missouri south through Arkansas into Louisiana and southwest through Oklahoma into Texas. East of the Mississippi it is local in the Carolinas, Georgia, (with one locality known for Middle Tennessee), and Mississippi. The bright pale blue flowers, borne in long spikelike racemes make it one of our handsomest natives.

6. DELPHINIUM VIRESCENS Nutt., Gen. N. Am. Pls. 2:14. 1818.

Delphinastrum virescens (Nutt.) Nieuwl., Am. Midl. Nat. 3:172. 1914.

Stems solitary or few from a thickish, erect caudex, this branching at its base into thickish roots or a fascicle of fusiform tuberous roots, erect, 2-10 dm tall, terete, slender but firm, the lowest internodes shortest, greenish or tan, rarely with some maroon tints, smooth, gradually lengthening toward mid-stem, there longer than the shortening petioles and blades; stem surfaces (in ours) usually smooth up to mid-stem, from there upward becoming

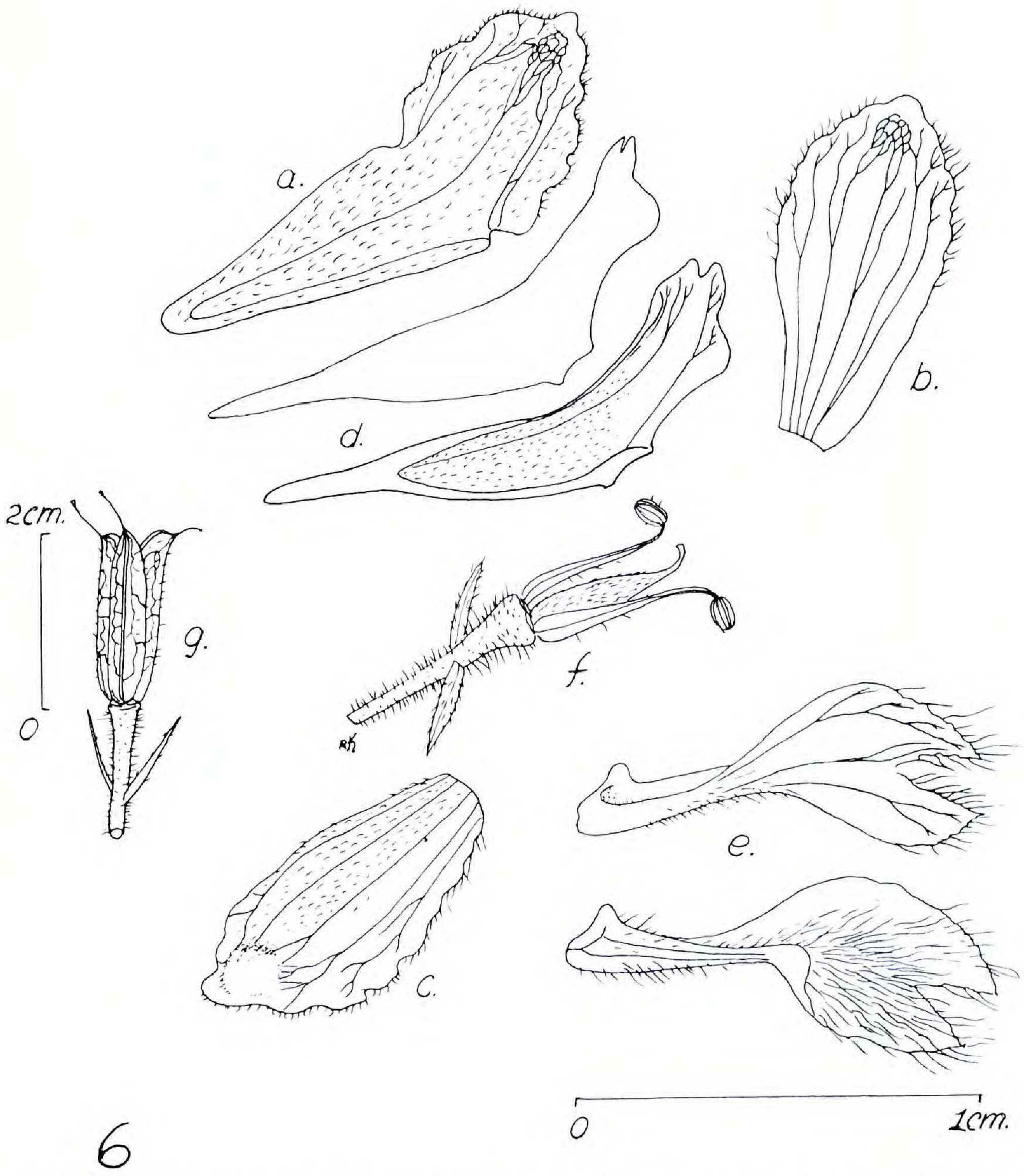


Figure 6. *Delphinium virescens* Nutt. a. Spur sepal, spur spread, outer surface. b. Lower lateral sepal, inner surface. c. Upper lateral sepal, outer surface. d. Spur petals. e. Claw petals, the lower showing upper (inner) surface of blade. f. Pedicel, receptacle, stamens, carpel. g. Mature fruit. (Flower and fruit from *Blum 3615*.)

increasingly pilose with whitish or yellowish trichomes, the longer ones pustular-based and frequently gland-based, these in the inflorescence intermingled with shorter, incurved hairs. Lowest leaves usually dying back by anthesis, the lower green ones with ascending, smoothish (or scattered-pubescent) petioles longer than the tenuisected blades, these in outline semicircular to suborbicular, the primary divisions usually 3, each linear-based

and pinnatifid, the secondary segments broadly to narrowly linear, these simple or themselves distantly pinnatifid; segment apices long-to-short-acuminate, each mucro-tipped with a low callus; segment surface nearly smooth, with incurved trichomes along the margins and primary veins, pale green. Inflorescence a single, narrowly-elongate raceme or a sparingly, ascending-branched system of these, the flowers numerous on shortish, erect to strongly ascending, hispidulous-hirsute, slender pedicels, each subtended by a linear, pilose bract, and bearing distally a pair of short-linear pubescent bracteoles. Sepals usually yellowish-white, tinted with a suggestion of blue, lavender or violet or sometimes a dull near-blue. Spur sepal 1.5-2.2 cm long, the narrowly conic spur ca. ⅔ the total length, the blade bent upward, ovate, the tip rounded-squarrose, the margin sinuate-crispate, the outer surface incurved puberulent, denser and villosulous in the area of the deeper-colored subapical pouch, the inner surfaces largely smooth. Other sepals oblong or narrowly obovate, slightly asymmetrical, 1.0-1.2 cm long, the apices narrowly rounded, the margins sinuate-erose, long-ciliate, the outer surface puberulent, strongly so in the area of a large shallowly-saccate subapical pit, the inner surfaces essentially smooth. Spur petals about the length of the spur sepal, off-white, the closed portion of the spur narrow, ca. 5-7 mm long, thence expanding to the attachment point ca. 1.5 cm from the spur tip; lower edge of the blade with a broad, shallow sinus between callused lobes, the blade apex ovate, bifid, thus tipped with 2, narrowly triangular teeth, the surfaces smooth save for minute puberulence within the spur. Lower petals ca. 1 cm long, the claw ca. 5 mm long, bearing at its short tubular base an upwardly directed low spur ca. 1 mm long; blades downwardly bent, ovate, acute, long-ciliate, nearly split by a deep, narrowly triangular, acute sinus, yellowish-white, the upper surface villous with long, yellowish-white hairs, the backs essentially glabrous. Stamens ca. 7 mm long, the anthers ca. 1 mm long, the anther locule backs and the filament margins often with a scattering of weak hairs. Carpels with ovaries lance-cylindrical, acuminate, tomentulose, ca. 2 mm long, the styles yellowish, ca. 1 mm long, smooth. Follicle bodies asymmetrically oblong, erect, spreading only apically, 1.5-2.2 cm long, the persistent styles ca. 3 mm long, the surfaces puberulent and veiny. Seeds similar in size and sculpture to *D. carolinianum*.

D. virescens is a species of heavy, calcareous soils of cedar barrens, prairies, and rocky clearings through most of middle Tennessee and from one disjunct locality in northern Alabama. It flowers from April through most of June. Our examples all fit Professor Ewan's description (1945) of the variety *virescens* which has a distribution, in prairies, from southern Canada southward into north-central Texas. East of the Mississippi it is rare in Illinois and Kentucky, but quite abundant in several counties of Tennessee.

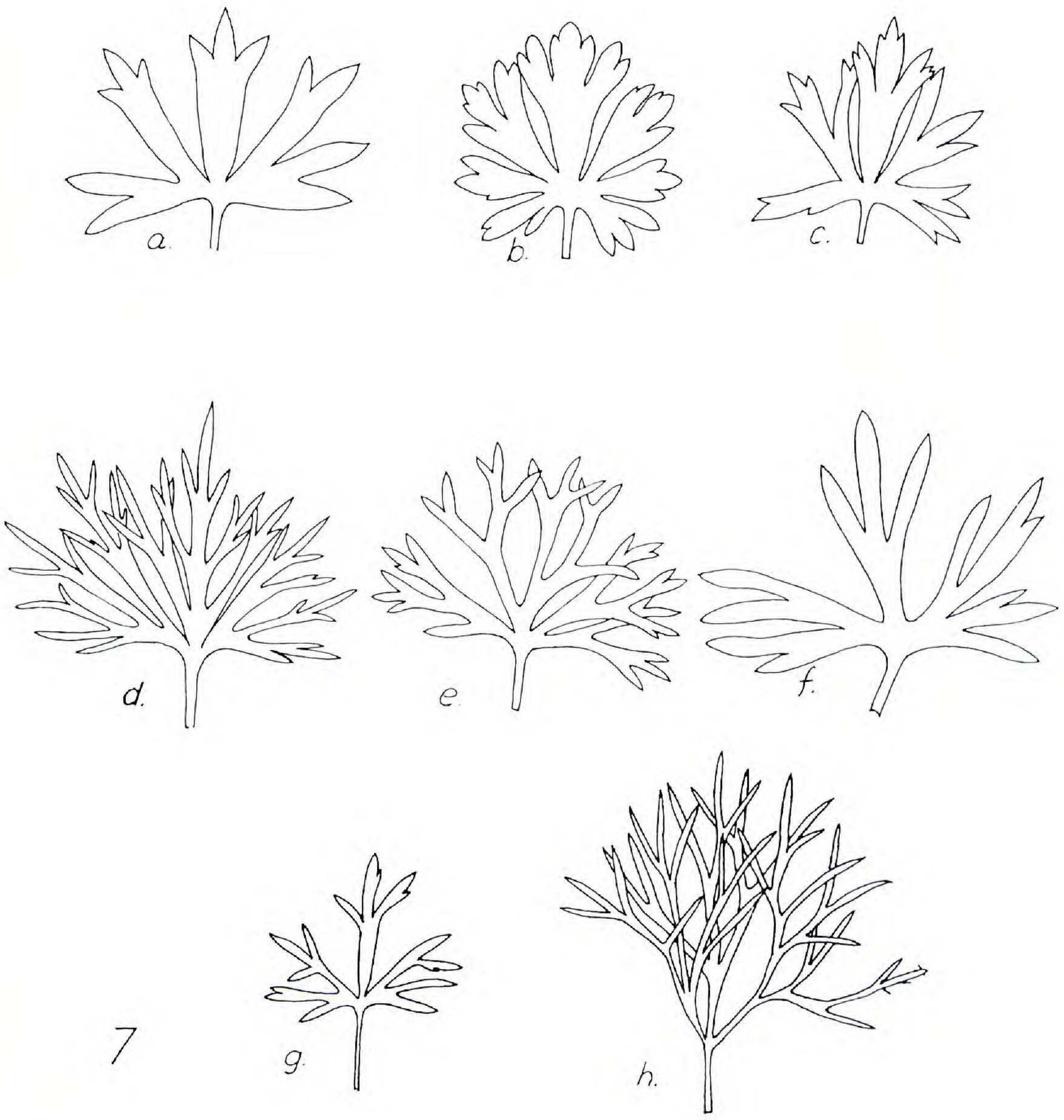
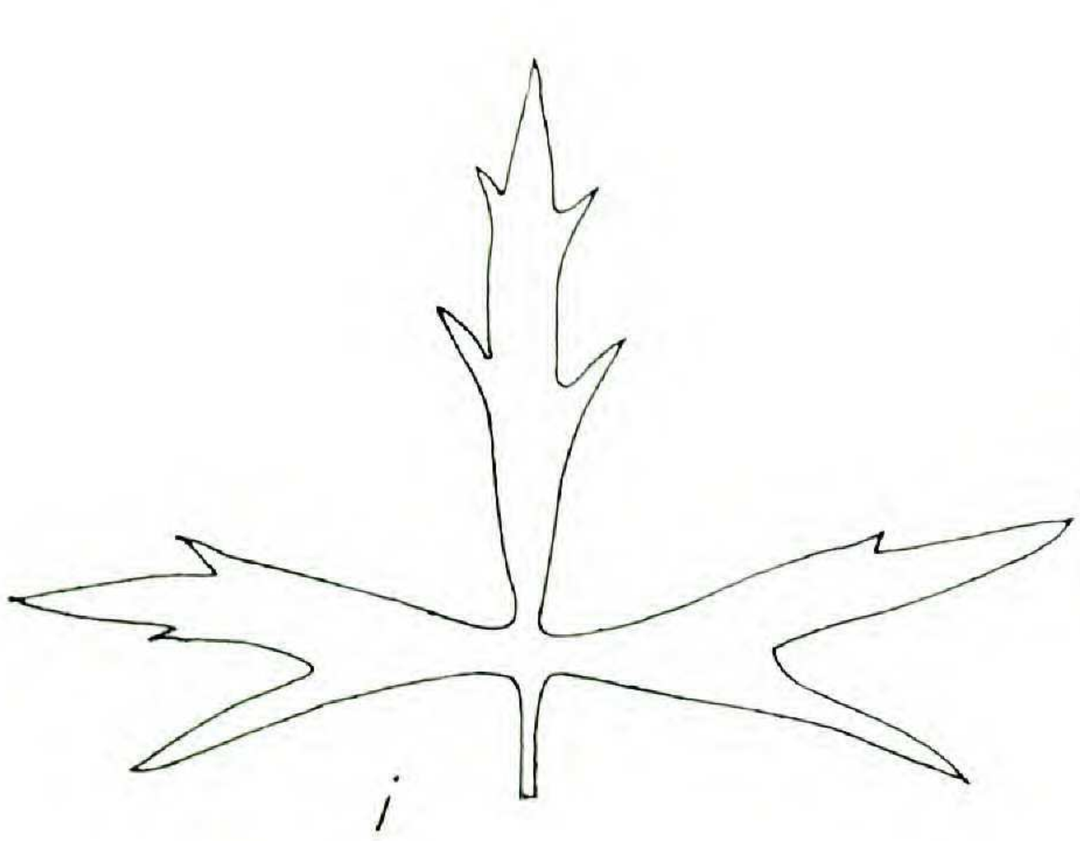
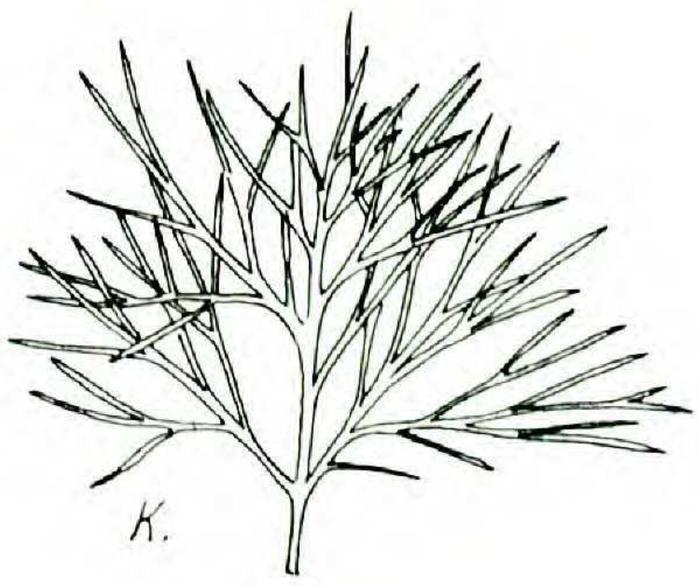
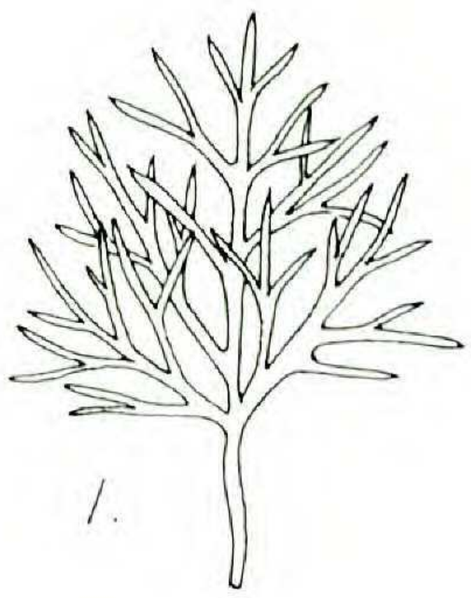


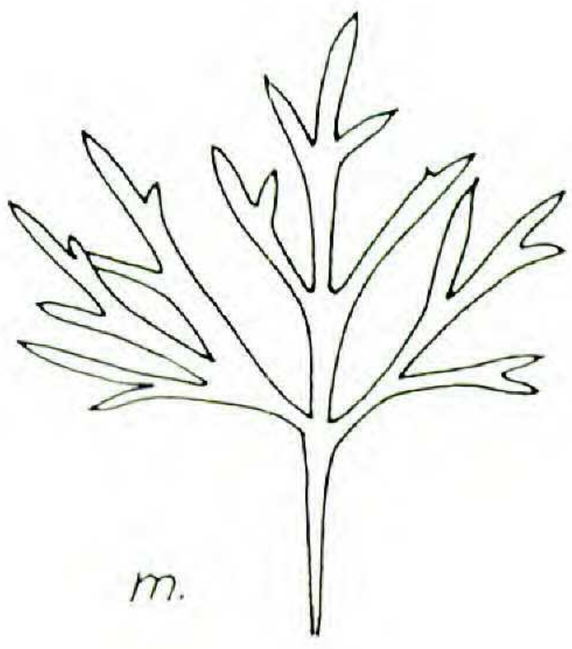
Figure 7. Some outlines representing basal leaf blades of *Delphinium* species. *D. tricorne* Michx.: a. *Angel 30*; b. *F. wolf*, 26 Apr. 1940; *c. Bernard 24. D. alabamicum* Kral: d., e., f. *Kral 39113* (holotype). *D. carolinianum* Walt.: g. *Thomas 18669*; h. *Kral 44019*.

There is no doubt that it is taxonomically very close to *D. carolinianum*, which it closely resembles in habit, leaf, pubescence, sepal and petal characters (including the saccate perianth tips), stamens, and seed. Indeed, pigment characters and minor corolla characters distinguish it at best. In Missouri, where populations of the two species appear to overlap, it would be of interest to note if intermediates occur.









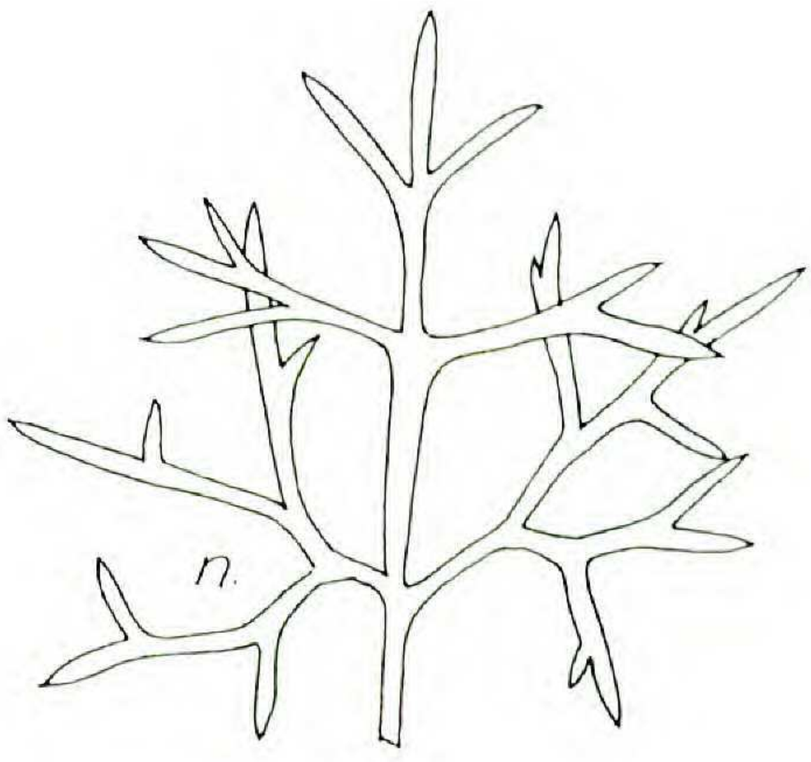


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Figure 8. Some outlines representing basal leaf blades of *Delphinium* species. *D. exaltatum* Ait.: i. *Bozeman 10701*; j *Kral 11137. D. ambiguum* L.: k.. l. *Kral 28509. D virescens* Nutt.: m., n. *Kral 39163.*

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